

Release of Germplasm Resistant to Multiple Races of Potato Cyst Nematodes

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ABSTRACT

Seeds of three progenies segregating for resistance to two pathotypes of *Globodera rostochiensis* (Ro1 and Ro2) and two pathotypes of *G. pallida* (Pa2 and Pa3) are being released by the Cornell University Experiment Station and the USDA/ARS. This resistance is in a form suitable for North American production and was developed for use in the event that pathotypes of *G. pallida*, which are prevalent in many other potato production areas of the world, are ever introduced into North America. The source of the resistance is germplasm obtained in 1984 from the International Potato Center in LaMolina, Peru. The combined resistance in this germplasm is from *S. tuberosum* ssp. *andigena* and *S. vernei*. Resistance to PVY is also segregating in two of these progenies.

INTRODUCTION

In many parts of the world, potato cyst nematodes, *Globodera rostochiensis* and *Globodera pallida*, cause serious problems in potato production and distribution. In the United States, *G. rostochiensis* has been identified on some farms on Long Island and a few upstate New York farms. Only pathotype Ro1 (race R₁A; Canto and Scurrah 1977) of *G. rostochiensis* was recognized until 1994, when pathotype Ro2 (race R₂A; Canto and Scurrah 1977) of *G. rostochiensis* was identified on one farm on Long Island and on the experimental farm in western New York. In the 60 years since the discovery of this pest in New York, its spread has been

successfully restricted by quarantine procedures including systematic surveys, fumigation, regulation of equipment movement, elimination of host crops, and use of resistant varieties. In anticipation that world trade might be a source of a new introduction and that a new introduction would likely be a pathotype of *G. pallida*, in 1984 true seeds of a population with multiple resistance was obtained from Dr. Scurrah (Scurrah and Franco 1987) at the International Potato Center. Since then, this resistance has been integrated into an adapted genetic background that contained resistance to *G. rostochiensis* Ro1 (Brodie *et al.* 1991).

METHODS

The cyst nematode resistance project was initiated by Dr. Scurrah at CIP in 1974. Resistance to *G. pallida* pathotype Pa3 (race P₅A; Canto and Scurrah 1977) came from cultivars of *S. tuberosum* ssp. *andigena*. A group of clones included in CIP's germplasm collection called Hualash (CIP Nos. 700031, 700041, 700166, 701513, and 701422) displayed partial resistance. Intercrosses among these clones revealed that the progeny displayed a very high level of resistance to one population of *G. pallida* in Peru. Later, selections from progenies of crosses among these andigena clones were crossed to a hybrid between *S. vernei* and ssp. *tuberosum* developed at Wageningen, Netherlands. This hybrid displayed high levels of resistance to populations of *G. pallida* pathotype Pa2 (race P₄A; Canto and Scurrah, 1977). Seeds of 24 progenies obtained by crossing these andigena and hybrid selections with bulked pollen of both sorts were provided by CIP to Cornell. These seeds were sown and transplanted to 15-cm pots in the greenhouse in 1985. Multiple tubers were harvested, and in 1986 four tubers from each clone were sent to CIP in Peru for evaluation for resistance to the two pathotypes of *G. pallida*. Information from these evaluations was

used to identify the resistant tubers of the same clones held at Cornell. These clones (H601-1 to H624-7) were used as female parents in 1987 that were crossed to bulk pollen from several neotuberosum x tuberosum hybrid parents selected for resistance to PVY and to *G. rostochiensis* Ro1 (Figure 1). The same procedure of producing multiple seedling tubers in the greenhouse and using these in evaluation trials at CIP and keeping some in reserve at Ithaca was repeated. In this generation, 22 clones (L101-1 to L127-3) were selected. In 1989, bulk pollen of these 21 clones was used to pollinate Atlantic. The seeds of this cross were designated as N42. In the next three years these siblings were selected for tuber type, virus resistance, *G. rostochiensis* (Ro1) and *G. pallida* (Pa2 and Pa3) resistance, and resistance to root lesion nema-

todes, *Pratylenchus penetrans*. Resistance to *G. pallida* was evaluated by CIP personnel in Bolivia and to *G. rostochiensis* and *Pratylenchus penetrans* in Ithaca. In 1992, eight clones selected for root lesion nematode resistance were used as a source of bulk pollen to pollinate the same set of clones. Among these were N42-10 which was the female parent of R3-6, N42-14 the female parent of R6-4 and R6-15, and N42-16 the female parent of R8-1. All four "R" generation clones were resistant to pathotypes Ro1 and Ro2 of *G. rostochiensis*, and to pathotypes Pa2 and Pa3 of *G. pallida*. None were particularly resistant to *Pratylenchus* and only R6-15 and R8-1 were considered to have resistance to PVY. In 1997, the following crosses produced over 10,000 seeds each:

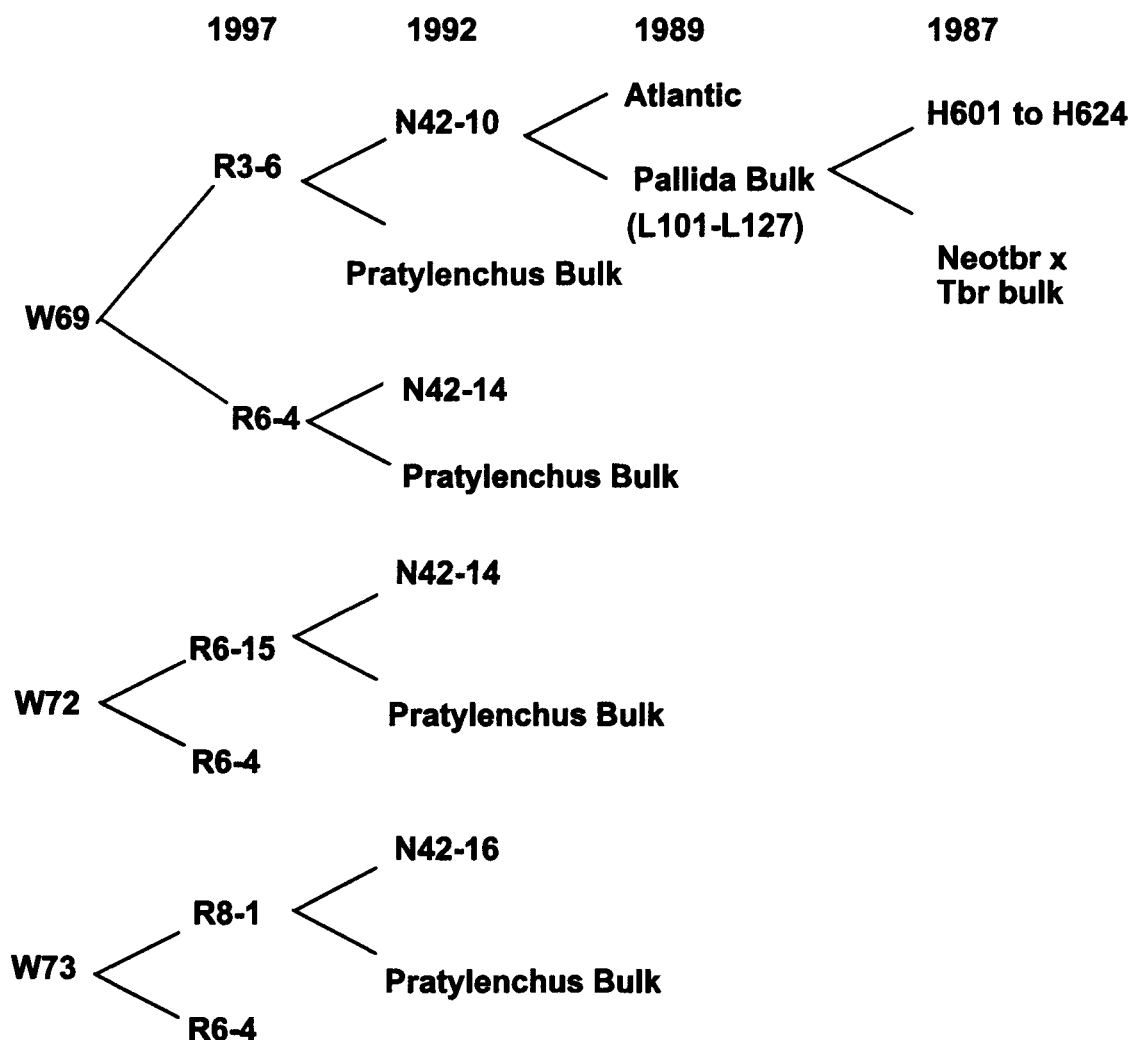


FIGURE 1.
Pedigrees of W69, W72, and W73.

W69 = R3-6 x R6-4

W72 = R6-15 x R6-4

W73 = R8-1 x R6-4

These pedigrees are presented in Figure 1, and the composition of the bulk pollinations are given in Table 1.

SEED AVAILABILITY

True seeds of these three progenies have been given to the NRSP-6 project at Sturgeon Bay, Wisconsin, for inclusion in their long-term storage facility. Samples of these progenies will be provided upon request. They will be available from the potato breeding project at Cornell as long as seed viability is good.

LITERATURE CITED

- Brodie, B.B., R.L. Plaisted, and M.M. de Scurrah. 1991. The incorporation of resistance to *Globodera pallida* into *Solanum tuberosum* germplasm adapted to North America. *Am Potato J* 68:1-11.
- Canto-Saenz, M. and M.M. de Scurrah. 1977. Races of the potato cyst nematode in the andean region and a new system of classification. *Nematologica* 23:340-349.
- Scurrah, M. and J. Franco. 1987. Contribution of *S. andigenum* and *S. vernei* - *S. tuberosum* in potato cyst nematode resistance for the

TABLE 1.—*Clones included in sources of bulk pollen.*

1992 <i>Pratylenchus</i> Bulk		1989 <i>Pallida</i> Bulk
N42-7	L101-1	4601-1 x Neotbr x tbr
N42-10	L101-2	
N42-11	L108-1	H609-2 x Neotbr x tbr
N42-14	L109-2	
N42-16	L109-3	
N42-23	L109-4	
N42-35	L112-1	H611-3 x Neotbr x tbr
N42-121	L114-1	H612-2 x Neotbr x tbr
	L114-2	
N42=Atlantic x Pallida Bulk	L115-1	H612-3 x Neotbr x tbr
	L116-1	H612-4 x Neotbr x tbr
	L116-2	
	L117-1	H613-1 x Neotbr x tbr
	L117-2	
	L118-1	H614-1 x Neotbr x tbr
	L118-2	
	L119-1	H614-4 x Neotbr x tbr
	L123-1	H624-3 x Neotbr x tbr
	L126-1	H624-6 x Neotbr x tbr
	L127-1	H624-7 x Neotbr x tbr
	L127-2	
	L127-3	